We claim:

1. A communication system for simultaneous transmission, reception and restoration of a plurality of individual signals superimposed in space and frequency, comprising

   a plurality of collocated transmitter antennas transmitting signals which reuse a common frequency band,

   a plurality of collocated receiver antennas receiving signals which reuse a common frequency band,

   a set of filters, having at least one filter, which is used to process the said received or transmitted signals, and

   at least one summing node which sums the signals produced by the said filters restoring at least one original individual signal and reducing the interference resulting from simultaneous transmission of a plurality of signals..

2. The communication system recited in claim 1 where the separation between the transmitting antennas as well as the separation between the receiving antennas are optimized relative to the distance between the transmitter site and the receiver site so that when, during the restoration of individual signals, the interfering signal is removed, the desired signal is extracted with a constructive superposition.

3. The communication system recited in claim 1 where each individual signal is assigned to a single transmitting antenna and the signal restoration is performed in the receiving system.

4. The communication system recited in claim 3 wherein the signal restoration is performed, on the received signals at the carrier (or an intermediate) frequency.

5. The communication system recited in claim 3 wherein the received signals are first translated to baseband and the restoration of the signals is performed at baseband.

6. The communication system recited in claim 3 which contains means which define the attributes of the said set of filters using training signals.

7. The communication system recited in claim 3 which contains means which define the attributes of the said set of filters during the pausing of the transmission of one or more of the transmitted signals.

8. The communication system recited in claim 5 where the said set of filter's responses are estimates of the responses of the propagation channels between various combinations of transmitter/receiver antenna.

9. The communication system recited in claim 5 where at least one filter in the set of filters is each reduced to a single tap adjusting the phase and amplitude of the received signal.

10. The communication system recited in claim 4 where at least one filter is reduced to a phase shifter and amplitude adjustment.

11. The communication system recited in claim 3 which contains means which define the attributes of the said set of filters, using a pilot tone signal which is injected alternately into each transmitted signal in a way that does not interfere with the transmitted data signals.

12. The communication system recited in claim 5 which contains means which define the attributes of the said set of filters using spread spectrum signals which are overlaid on each of the said set of data signals.

13. The communication system recited in claim 1 where the signals entering the transmitting system are filtered and premixed in the said system so that the restoration process may be accomplished directly by the physical summing of radio waves on the individual receiving antennas.

14. The communication system recited in claim 13 where a feedback signal from the receiving system to the transmitting system is used to control the signal premixing.

15. A communication system recited in claim 1 comprising some signal premixing at the transmitter site and some signal restoration at the receiving site.

16. A communication system recited in claim 1 including diversity means known from the prior art, wherein the diversity means provide for the system's information throughput increase approximately proportional to the diversity order, and the simultaneous transmission of individual signals superimposed in space and frequency provides for an additional information throughput increase approximately proportional to the number of superimposed signals.

17. A communication system recited in claim 16 processing two orthogonally polarized electromagnetic signals.

18. A method for simultaneous transmission, reception and restoration of a plurality of individual signals superimposed in space and frequency, comprising transmitting and receiving a plurality of signals where the transmitting antennas

    are collocated and the receiving antennas are collocated and the said antennas reuse a common frequency band,

applying a set of filters, containing at least one filter, to the said received or transmitted signals, and

summing the signals processed by the said filters restoring at least one original signal and reducing the interference resulting from the simultaneous transmission of a plurality of signals.

19. A method recited in claim 18 where the separation between the transmitting antennas as well as the separation between the receiving antennas is optimized relative to the distance between transmitting antennas and receiving systems so that when the interfering signal is removed the desired signal is extracted with a constructive superposition.

20. The method recited in claim 18 where each individual signal is assigned to a single transmitting antenna and the signal restoration is performed in the receiver.

21. The method recited in claim 20 where the said set of filter attributes are defined using training signals.

22. The method recited in claim 20 wherein the said set of filter attributes are defined during the pausing of the transmission of one or more of the transmitted signals.

23. The method recited in claim 20 where the said set of filter's response's are estimates of the responses' of the propagation channels between various combinations of transmitter/receiver antenna.

24. The method recited in claim 20 where the channel propagation matrix is defined and subsequently inverted.

25. The method recited in claim 20 where the said set of filter attributes are determined by adaptive techniques.

26. The method recited in claim 20 where an additional signal is injected in a way that does not interfere substantially with the transmitted data signals, and the said additional signal is subsequently cancelled, thereby canceling the interferers.

27. The method recited in claim 20 where an additional signal is injected in a way that does not interfere substantially with the transmitted data signals, and the said additional signal is used to estimate the said set of filter's attributes.

28. The method recited in claim 18 where the original signal filtering and premixing is done in the transmitter so that the restoration process may be accomplished directly by the physical summing of radio waves on the individual receiving antennas.

29. A restorer apparatus for use in a system utilizing simultaneous transmission of multiple radio signals superimposed in space and frequency, comprising

interface means to a plurality of collocated receiver antennas processing signals which reuse a common frequency band,

a set of filters, consisting of at least one filter, which is used to filter the said received signals, and

at least one summing node which sums the signals produced by said filters restoring at least one original individual signal and reducing the interference resulting from simultaneous transmission of a plurality of signals.

30. The restorer apparatus of claim 29 using training patterns and pauses in the transmitted signals and where the said set of filters attributes are calculated by estimation and inversion of a propagation channel matrix.

31. The restorer apparatus of claim 29 using pauses in at least one of the transmitted signals, canceling the interference at the output of at least one summing node during pauses, using an adaptive algorithm which adapts attributes of the said set of filters.

32. The restorer apparatus of claim 29 using training patterns and pauses in the transmitted signals to estimate propagation channel responses, and applying these to the said set of filters.

33. The restorer apparatus of claim 29 using pilot tone signals where the said set of filters attributes' are calculated by estimating a propagation channel matrix based on the phases and amplitudes of the received pilot tones, and inverting the said matrix.

34. The restorer apparatus of claim 29 using at least one pilot tone signal, canceling the pilot tone at the output of at least one summing node, using an adaptive algorithm which adapts attributes of the said set of filters.

35. The restorer apparatus of claim 29 using additional spread spectrum signals in the transmitted signals, to estimate propagation channel responses, and applying these to the said set of filters.

36. The restorer apparatus of claim 29 using at least one spread spectrum signal, canceling the spread spectrum signal at the output of at least one summing node, using an adaptive algorithm which adapts attributes of the said set of filters.